Appendix 3

All pending claims (claims 2, 5, 8, 10-33, and 37): clean copy (37 C.F.R. §1.121(c)(3)).

2. (Once amended) A method of cooling a surface by nucleate boiling, comprising:

polishing said surface;

photo etching said surface to obtain a predetermined minimum surface density of discrete nucleation sites having a conical cross-section tapering to at least a minimum predetermined depth;

immersing said surface in a refrigerant having a preselected boiling point so that said nucleation sites become substantially flooded by said refrigerant; and

permitting said surface to heat up to a temperature of at least said preselected boiling point, said heating initiating nucleate boiling of said refrigerant without a temperature overshoot on the initial ascent,

wherein said conical cross-section has a cavity cone angle, θ, which is greater than the liquid contact angle, γ, of said refrigerant.

5. (Once amended) The method of claim 2, wherein said refrigerant has a liquid contact angle of less than about 5°.

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8. (Once amended) ~~The method of claim 2, wherein said~~ nucleate boiling initiates with a reversal of trend of less than about 2°C.

10. A method of cooling an electronic component having at least one electronic chip means thereon, comprising:

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photo etching a back surface of said chip means to provide thereon a predetermined minimum surface density of discreet, nucleation sites, each having a conical cross-section tapering to at least a minimum predetermined depth;

immersing said back surface of said chip in a refrigerant having a preselected boiling point so that said nucleation sites become substantially flooded by said refrigerant;

operating said electronic component so that said back surface of said chip is heated to at least said boiling point, said heating initiating nucleate boiling of said refrigerant without a temperature overshoot on the initial ascent.

11. The method of claim 10, wherein said nucleation sites comprise spaced reverse-pyramidal cavities lying substantially on the same plane and having a first dimension of less than about 10μm.

12. The method of claim 11, wherein said nucleation sites include a spacing of less than about 60μm.

13. The method of claim 11, wherein said nucleation sites include a spacing of less than about 40μm.

14. The method of claim 11, wherein said nucleation sites include a spacing of less than about 20μm.

15. The method of claim 10, wherein said back surface contains a mirror-polished region including a plurality of nucleation sites having substantially the same geometric configuration.

16. The method of claim 12, wherein said nucleation sites comprise inverted square pyramids having a side dimension of at least about 10μm and a depth greater than 5μm.

17. A heat transfer system, comprising:

a heat transfer surface including a minimum surface density of discrete, nucleation sites having a conical cross-section tapering to a minimum predetermined depth;

a refrigerant having a preselected boiling point disposed in contact with said surface so as to substantially flood said

nucleation sites, said nucleation sites permitting nucleate boiling of said refrigerant without a temperature overshoot on the initial ascent.

18. The system of claim 17, wherein said conical cross-section includes a cavity cone angle, θ, which is greater than the liquid contact angle, γ, of said refrigerant.

19. The system of claim 17, wherein said minimum predetermined depth is greater than about 3μm and a significant portion of said sites have an aspect ratio greater than about .3.

20. The system of claim 17, wherein nucleation sites include a spacing of less than about 60μm.

21. The system of claim 17, wherein said nucleation sites comprise reverse-pyramidal cavities.

22. The system of claim 17, wherein said nucleate boiling occurs by a plurality of bubbles exiting said sites substantially independently from a wake of a neighboring bubble.

23. The system of claim 17, wherein said nucleation sites are spaced a minimum distance apart so that flooding of said sites by

said refrigerant is substantially independent of neighboring departing bubbles.

24. The system of claim 17, wherein a substantial portion of said nucleation sites are about the size of a vapor embryo remaining after sites have become substantially flooded.

25. An electronic component cooling system comprising the heat transfer system of claim 17, whereby the refrigerant is boiled on said surface to cool said component.

26. A gas generation system comprising the heat transfer system of claim 17, whereby said refrigerant is boiled to form said gas.

27. A heat transfer system including an electronic component, comprising:

a chip including a back surface having thereon a region which has been photo etched to provide a predetermined minimum surface density of discrete, nucleation sites, each having a conical cross-section tapering to at least a minimum predetermined depth;

a refrigerant having a preselected boiling point disposed in contact with at least the back surface of said chip so as to substantially flood said nucleation sites, said nucleation sites

permitting nucleate boiling of said refrigerant without a temperature overshoot on the initial ascent.

28. A heat transfer system for producing a gaseous product from a liquid, comprising:

a surface having thereon a region which has been photo etched to provide a predetermined minimum surface density of discrete, nucleation sites, each having a conical cross-section tapering to at least a minimum predetermined depth;

a liquid having a preselected boiling point disposed in contact with said surface so as to substantially flood said nucleation sites, said nucleation sites permitting nucleate boiling of said liquid to form said gaseous product without a temperature overshoot on the initial ascent.

29. The heat transfer system of claim 28, wherein said liquid is a cryogenic liquid.

30. The heat transfer system of claim 29, wherein said boiling occurs at a heat transfer coefficient exceeding about $1W/cm^2{}^\circ C$.

31. The system of claim 28, wherein said conical cross-

section includes a cavity cone angle, θ, which is greater than the liquid contact angle, γ, of said liquid.

32. The system of claim 28, wherein said minimum predetermined depth is greater than about 3µm and a significant portion of said sites have an aspect ratio greater than about .3.

33. The system of claim 28, wherein said nucleation sites include a spacing of less than about 60µm.

37. (New) A method of cooling a surface by nucleate boiling, comprising:

(a) providing a polished, photo etched surface having a predetermined minimum surface density of discrete nucleation sites having a generally conical cross-section tapering to at least a minimum predetermined depth, wherein said nucleation sites comprise spaced reverse-pyramidal cavities lying substantially on the same plane and having a first cross-sectional dimension of less than about 10µm, and a spacing of less than about 20µm;

(b) immersing said surface in a refrigerant having a liquid contact angle of no greater than about 5° and a preselected boiling point, said nucleation sites become substantially flooded with said refrigerant; and

(c) causing said surface to heat up to a temperature of at least said preselected boiling point, said heating initiating nucleate boiling of said refrigerant without a reversal of trend.